NASA Langley's
Pressure Regulators for Fluid Flow Simulations

Improved transient modeling

NASA Langley has developed a software technology for modeling the fluid flow behavior of an in-line mechanical pressure regulator within a fluid simulation system. The algorithms and code were developed to accurately account for transient flow behaviors that occur at pressure regulators, something static models do not. The pressure regulator model was developed to extend the modeling capability of NASA's commercially available Generalized Fluid System Simulation Program (GFSSP). This pressure regulator modeling software will more accurately reflect real-world conditions throughout the operating regime for two-phase systems as well as single-phase systems. The novel NASA algorithm is more accurate and robust under start-up and transient cases, and monotonically converges on a stable and steady state solution. NASA is looking for development partners, particularly those using or interested in the NASA GFSSP.

Benefits

- Improved modeling of pressure regulators in a modular "plug-in" software format
- Validated algorithm for modeling one or more pressure regulators
- Accurate real-world transient flow conditions
- Use in both single-phase and two-phase systems
- Instabilities of rearward-looking model eliminated in forward-looking model

partnership opportunity

Applications

The technology offers wide-ranging market applications, including:

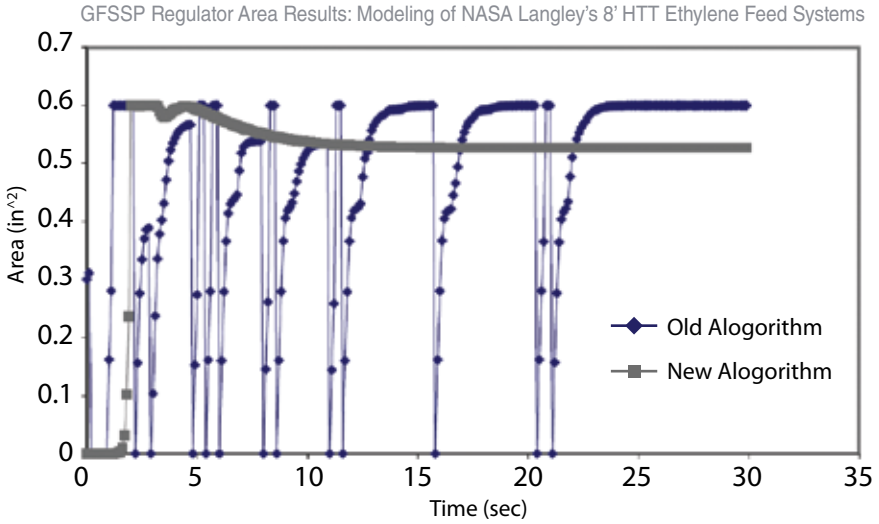
- Chemical process control
- Hydraulics
- Water, gas, and electrical generation utilities
- Pipeline network design
- Transient flow modeling market – analysis of piping stress loads
- Water hammer and pressure relief problems
- Under-damped solution

NASA programs that have used the algorithm to model high pressure gaseous blow-down systems include:

- Hyper-X (8500 psi nitrogen regulation for purge and coolant pressurant)
- GDE-2 (1500 psi ethylene regulation of fuel for scramjet testing)
- IRVE-I, II (3000 psi nitrogen regulation for inflatable deployment of aeroshell)

The Technology

Typical pressure regulator models assume a steady state, fixed pressures, based on a rearward calculation, which does not reflect real-world transient behavior and system instabilities. To address the shortcomings of typical models NASA developed a forward-looking, time-dependent algorithm that more accurately reflects real-world transients. The subject, patent pending method provides a pressure regulator model that accurately models transient conditions and furnishes a much more realistic simulation of one or more regulators. NASA Langley developed the innovative algorithm to resolve problems with the NASA patented GFSSP. The inventors had discovered inaccuracies in the results provided by the GFSSP pressure regulator model, especially when operating near a fluid's vapor dome. The new algorithm modeled a regulator by increasing or decreasing flow, within limits, in response to decreases or increases in downstream pressure, respectively. Although the technology was developed for GFSSP, the algorithm can be adapted to work with other similar commercial packages, either as a component or as a stand-alone 'plug-in.'



The graph shows the computed regulator area of the old algorithm compared to the new algorithm. The area fluctuations of the old algorithm lead to large pressure fluctuations.

For More Information

If your company is interested in licensing or joint development opportunities associated with this technology, or if you would like additional information on partnering with NASA, please contact:

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LAR-16885-1

TOA 65
NP-2009-09-185-LaRC